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Is the use of topical vancomycin to prevent mediastinitis after cardiac surgery justified?

To the Editor:

Patients undergoing cardiopulmonary bypass (CPB) are at substantial risk of acquiring infections because of the increased number of potential ports of entry of pathogens in the presence of CPB-induced impairment of immune responses.[1] Despite regular use of prophylactic intravenous antibiotics, postoperative mediastinitis occurs in 0.4% to 5% of patients undergoing cardiac operations.[1] This complication is associated with a 14% to 47% risk of in-hospital mortality.[1]

Gram-positive bacteria are the most common isolates from patients with mediastinitis; *Staphylococcus aureus* and *Staphylococcus epidermidis* are identified in 70% to 80% of cases.[1] In a prospective randomized controlled study, Vander Salm and associates[2] found that topical vancomycin applied during wound closure after median sternotomy was associated with a significant reduction in the rate of sternal wound infection. Although this study has not been repeated, its findings were accepted by a number of cardiac surgeons who have adopted the routine use of topical vancomycin powder to prevent mediastinitis after CPB (unpublished data).

The risk of vancomycin resistance has been a concern of those who have adopted this approach. However, 2 factors have supported the use of vancomycin for this purpose. First, the drug is instilled in a confined space, which prevents free movements of organisms in and out of the area at risk. Second, topical application of vancomycin was believed to result in insignificant serum levels. We have studied the pharmacokinetics of vancomycin powder instilled between the edges of the sternum during closure of the median sternotomy in 4 patients undergoing CPB. Contrary to the common belief that topical vancomycin powder is poorly absorbed, levels up to 4.4 mg/L were found in the patients' serum within 3 to 4 hours after topical application of 1 g of vancomycin powder (Fig 1).

Recent emergence of vancomycin resistance in methicillin-resistant *S aureus*[3-5] could raise doubts regarding the wisdom of continuing this approach. The first report of vancomycin resistance in methicillin-resistant *S aureus* occurred after a cardiac operation in a 4-month-old boy.[3] More recently, Smith and colleagues[4] have identified 2 more cases of *S aureus* with intermediate resistance to vancomycin. The mechanism of resistance, however, is not due to the acquisition of the feared *vanA* or *vanB* resistance genes that have been isolated from vancomycin-resistant enterococci.[5] *S aureus*–intermediate resistance to vancomycin is believed to be mediated by accumulation of cell wall components, with possible alternative vancomycin-binding pathways that divert vancomycin from its target site.

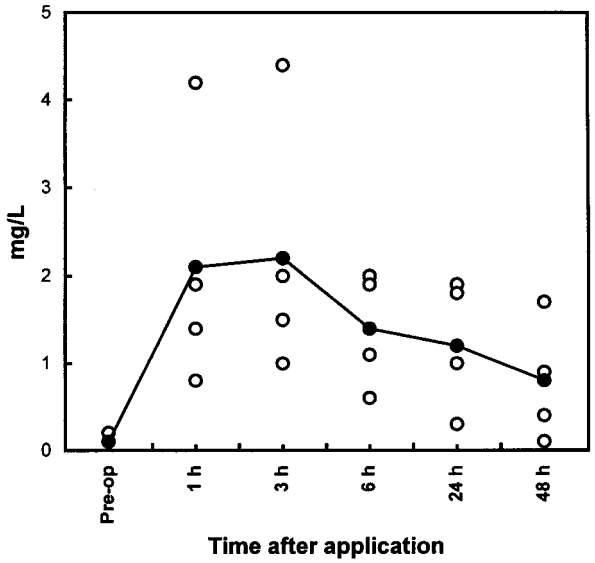

Fig 1. Vancomycin levels before and after instillation of 1 g of vancomycin powder between the sternal edges during wound closure. Vancomycin serum levels were measured before the operation and 1, 3, 6, 24, and 48 hours after instillation of vancomycin. The *solid line* represents the mean value of vancomycin levels in milligrams per liter obtained from 4 patients. The mean values are 0.1, 2.1, 2.2, 1.4, 1.2, and 0.8 mg/L, respectively.

We wish to debate this issue among the cardiothoracic surgeons and the experts in the field of antibiotic resistance. Such a debate will undoubtedly help to determine the risks versus the benefits of using topical vancomycin to prevent mediastinitis after median sternotomy.

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In vivo estimation of septal lung tissue volume and correlation with diffusing capacity in lung volume reduction surgery

To the Editor

We read with great interest the recent paper by J. C. Chen and associates[1] about the diffusing capacity limitations of the extent of lung volume reduction surgery (LVRS) in animal models of emphysema. The authors induced diffuse emphysema by aerosol elastase, a model similar to the homogenous type of human emphysema. However, patients with emphysema who are good candidates for LVRS tend to have heterogeneous targeted areas for resection,[2] as Cooper has mentioned.[1] In these patients, improvement in respiratory system compliance is prominent even after resection of a large volume of the lung. In contrast, diffusing capacity deteriorated when the resected volume exceeded a threshold. In the setting of major lung resection, diffusing capacity may predict the postoperative morbidity and mortality.[3] We believe that the importance of diffusing capacity in LVRS needs to be emphasized. The goal of LVRS should be a balance between improving mechanical function of the lung and diaphragm without excessive loss of diffusing capacity or of the pulmonary vascular bed. We congratulate Chen and associates for raising this important issue.

In Dallas, we[4,5] have performed extensive studies to determine the diffusion limitation after major lung resection at rest and during exercise. Here, we would like to introduce a method of assessing the diffusing capacity and septal lung tissue volume in vivo using combined radiologic and physiologic techniques. We believe this approach has potentially important applications in LVRS. With the use of an acetylene and a carbon monoxide rebreathing method, lung air volume, tissue volume, diffusing capacity, and cardiac output can be simultaneously and noninvasively measured.[4] In addition, tissue volume and air volume were also separately estimated by computed tomographic (CT) scan, from which topologic distribution of tissue and air volumes are obtained.[6] We compared tissue volume measured by these 2 techniques in immature dogs at different ages. Half the dogs had undergone resection of the right lung; the other half had undergone thoracotomy without lung resection. We[6] found significant correlations ($P < .01$) between tissue volume measured by CT and rebreathing and between tissue volume and diffusing capacity in both groups (Fig 1, *A* and *B*). These data suggest that tissue volume is an anatomic correlate of gas exchange capacity.

The article by Chen and associates reinforces the point that the key functional parameter of gas exchange is not total lung volume, but diffusing capacity and tissue volume. Measurement of diffusing capacity and tissue volume may aid the functional evaluation of patients with emphysema, although their predictive value in the setting of LVRS requires further investigation. For example, preoperative measurement of diffusing capacity and tissue volume by the rebreathing method could identify patients with insufficient gas exchange reserves who would not benefit from LVRS regardless of improvements in mechanical lung and respiratory muscle function. In addition, one could potentially use CT scan to map out the topologic distribution of tissue volume and to target regions with a low tissue volume (high air/tissue volume ratio) for resection.

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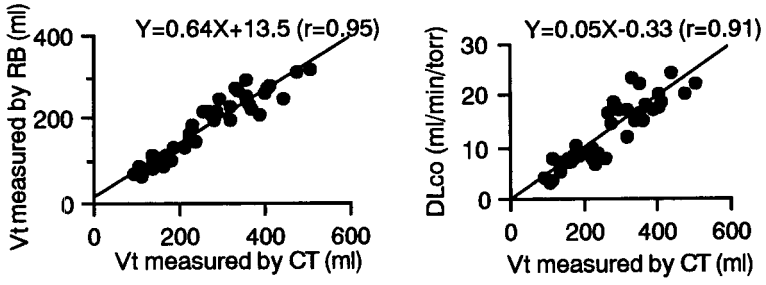

Fig 1. Measurement of tissue volume and diffusing capacity by computed tomography and rebreathing. *Vt*, Tissue volume; *RB*, rebreathing; *CT*, computed tomography; DL_{CO}, diffusing capacity of carbon monoxide.